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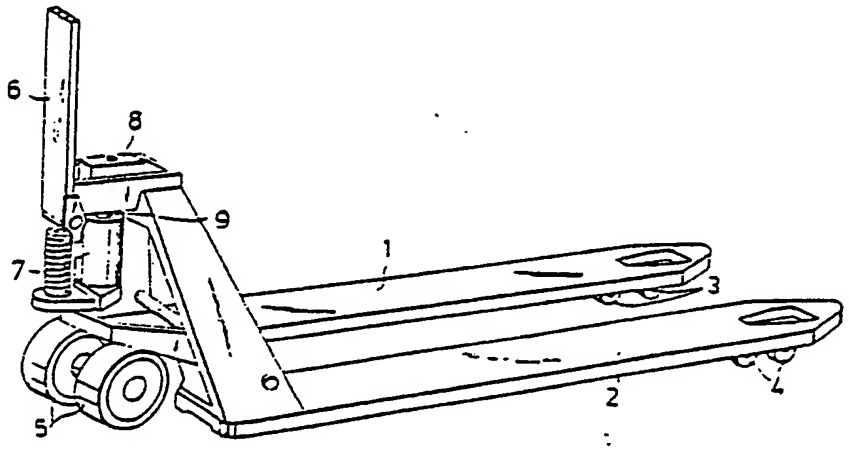
(54) Title: AN ELECTRONIC WEIGHING DEVICE FOR PALLET-LIFTING APPARATUSS



(57) Abstract

Electronic weighing device for a pallet-lifting apparatus having a substantially vertically arranged lifting piston-cylinder device (7). The weighing device includes a force-sensing means (8) with a force transducer arranged to absorb the force created when the lifting apparatus is loaded. Coupled to the force transducer is an electronic weight indicator and a limit switch arranged to close the current circuit to the weight indicator at a given level of the lifting forks (1, 2) of the pallet-lifting apparatus. The force-sensing means (8) with force transducer is mounted on the lifting cylinder (7) of the pallet-lifting apparatus.

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An electronic weighing device for pallet-lifting apparatus

The present invention relates to an electronic weighing device for pallet-lifting apparatus having a substantially vertically arranged lifting cylinder, said weighing device comprising a load-sensing means including a load-transducer arranged to absorb the forces obtained when the lifting apparatus is loaded; an electronic weight indicator coupled to the load transducer; and a limit switch arranged to close the current circuit to the weight indicator when the forks of the pallet-lifting apparatus reach a given level.

Known pallet-lifting apparatuses lack any form of weighing device which renders impossible the weight of individual packages to be checked when loaded onto a vehicle. Consequently, it is necessary to accept that the given weight of the package is correct. Unfortunately, this often means that the weight of the package is greater than the given weight, which means that the load carried by the vehicle is in excess of the lawful load.

An object of the present invention is to provide an electronic weighing device which can readily be fitted to existing pallet-lifting apparatuses, thereby to eliminate the aforementioned problem.

The weighing device according to the invention is characterized in that the load-sensing means and the load transducer are mounted on the lifting cylinder of the pallet-lifting apparatus. In accordance with a particularly preferred embodiment of the invention, the limit switch is arranged to close the supply of current to the

weight indicator only when the lifting forks move upwardly. The load transducer of the load-sensing means may comprise a wire strain gauge or an hydraulic transducer. The load-sensing means may be mounted at the top of the lifting cylinder or at the bottom thereof.

So that the invention will be more readily understood and further features thereof made apparent, an exemplary embodiment of the invention will now be described with reference to the accompanying drawings, in which

Figure 1A is a perspective view of a pallet-lifting apparatus provided with a load-sensing means according to the invention;

Figure 1B is a side view of a lifting cylinder having a load-sensing means according to the invention mounted thereon, said view being in larger scale than the scale of Figure 1A;

Figure 2 is a diagrammatic view of the current-supply circuit of the weight indicator, said circuit including a current source, a switch and a weight-sensing means;

Figure 3 is a diagrammatic side view of the pallet-lifting apparatus according to Figure 1; and

Figure 4 illustrates diagrammatically the forces and moments acting on the lifting apparatus.

The pallet-lifting apparatus illustrated in Figure 1B is a conventional lifting apparatus intended to move pallets, and then lifting them some centimeters by means of two lifting forks 1, 2 each of which is supported at one end on a respective pair of wheels 3 and 4. The forks are carried at the other end thereof by a pair of wheels 5, together with the remaining components of the lifting apparatus. The height of the forks 1, 2 above the ground is regulated hydraulically by means of operating means (not shown) arranged at the top of an operating bar 6. The height of the forks is controlled hydraulically by means of a substantially vertically arranged hydraulic piston-cylinder device 7. A load-sensing means 8 incorporating a load transducer according to the invention is mounted on the upper end of the piston rod 9 of the piston-cylinder

device 7. The load or weight sensing device can also be placed beneath the hydraulic lifting cylinder 7. In both cases, the sensing means absorbs the force created when the lifting apparatus is loaded. The weighing operation, effected with the aid of this load, is, however, dependent on the level of the piston in the cylinder and must therefore always be carried out at a given level of the piston of the piston-cylinder device. This level is determined by means of a limit switch.

Figure 1B illustrates in detail the construction of the piston-cylinder device 7. Piston rod 9 is provided at its upper end with a hardened plane washer 16 on which rests a ball 17 intended to reduce or eliminate bending in the radial direction of the rod. Ball 17 carries a bolt 18 having a spherical contact surface against the ball. The load-sensing means 8 is mounted on the bolt 18 and is supported by a stud 19.

The two pairs of wheels 3, 4 rest always on the floor, i.e. the wheels carry always the load in a pallet-lifting apparatus. Moreover, the package carried by the forks 1, 2 loads continuously the load transducer.

Figure 2 illustrates schematically the current supply circuit for a weight indicator 10 having a display unit 20 which is illuminated and can be read when reaching the given level of the piston of the piston-cylinder device. The transducer 11 of the weight or load sensing means is connected to the weight indicator 10 via an electric conductor 12. The weight indicator 10 is supplied with current from a battery or accumulator 13, having an operating time of approximately ten hours, whereat a limit switch 15 is incorporated in the conductor 14, between the indicator 10 and the battery 13. The switch 15 is arranged to close the circuit 14 at a given level of the piston of the piston-cylinder device, the display 20 of the indicator being energized so that the weight loading the forks 1, 2 can be read off. Thus, the indicator 10 is calibrated to give the correct weight at the given level of the piston, since the force exerted on the lifting cylinder, and there-

with on the load and weight sensing means is level dependent. The limit switch 15 is arranged to close the current circuit 14 only when the piston of the piston-cylinder device moves upwards. At a predetermined level the display unit 20 will then be illuminated and the weight of the package can be read off. When the forks 1, 2 are unloaded display unit 20 indicates zero at said level. A normal weighing operation lasts 10 - 15 seconds implying that the battery capacity suffices for approximately 2000 weighings. Before transporting the goods or pallets the forks 1, 2 are lowered until display unit 20 is switched off.

The load transducer can comprise either a wire strain gauge, so-called load cell, or a hydraulic force transducer.

In Figure 3 is illustrated schematically the operation of the lifting apparatus linkage system 21. By pumping out the piston in lifting cylinder 7 the lifting apparatus frame with forks 2 is raised from the floor. The force in cylinder 7 is sensed by load-sensing means 8. In order to attain a correct weight indication of the load on forks 2 the indication of the load figure must always occur at the same height from the floor. This will be explained with reference to Figure 4. Load G on wheels 4 loads the moment arm L_1. The moment around the fulcrum 22 is $GL_1 \cos \alpha$ and the force in linkage system bar 21 is then:

$$F_{st} = \frac{GL_1 \cos \alpha}{L_2 \cdot \sin \alpha}$$

This force F_{st} which is sensed by the load-sensing means 8 is thus dependent on angle and thus on the height of forks 2 above the floor.

CLAIMS

1. An electronic weighing device for pallet-lifting apparatus having a substantially vertically arranged lifting piston-cylinder device (7) including a load-sensing means (8) with a force transducer (11) arranged to absorb the force generated when the lifting apparatus is loaded; an electronic weight indicator (10) connected to the force transducer (11); and a limit switch (15) arranged to close the current circuit (14) to the weight indicator (10) at a given level of the lifting forks (1, 2) of the pallet-lifting apparatus, characterized in that the force-sensing means (8) with force transducer (11) is mounted on the lifting cylinder (7) of the pallet-lifting apparatus.

2. An electronic weighing device according to claim 1, characterized in that the limit switch (15) is arranged to close the current circuit (14) to the weight indicator (10) only during upward movement of the lifting forks (1,2).

3. An electronic weighing device according to claim 1 or claim 2, characterized in that the force transducer (11) is a strain gauge.

4. An electronic weighing device according to claim 1 or claim 2, characterized in that the force transducer (11), is a hydraulic transducer.

5. An electronic weighing device according to any one of claims 1 - 4, characterized in that the force-sensing means (8) is mounted on the top of the lifting cylinder.

6. An electronic weighing device according to any one of claims 1 - 4, characterized in that the force-sensing means is mounted beneath the lifting cylinder.

Fig. 1a

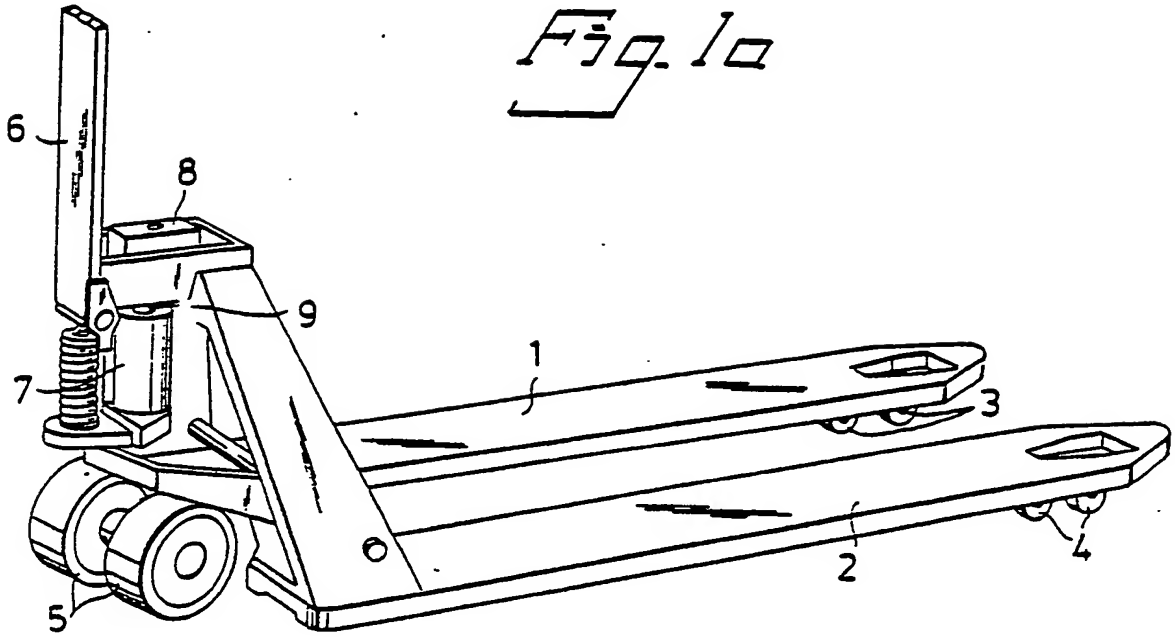

Fig. 1b

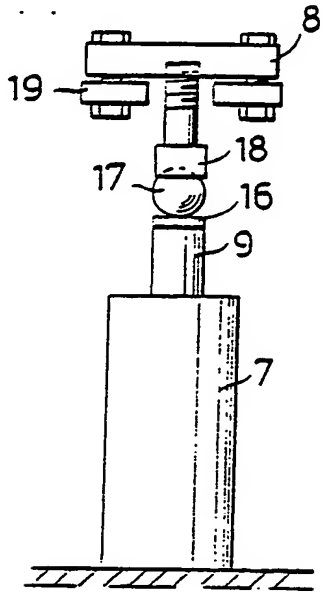

Fig. 2

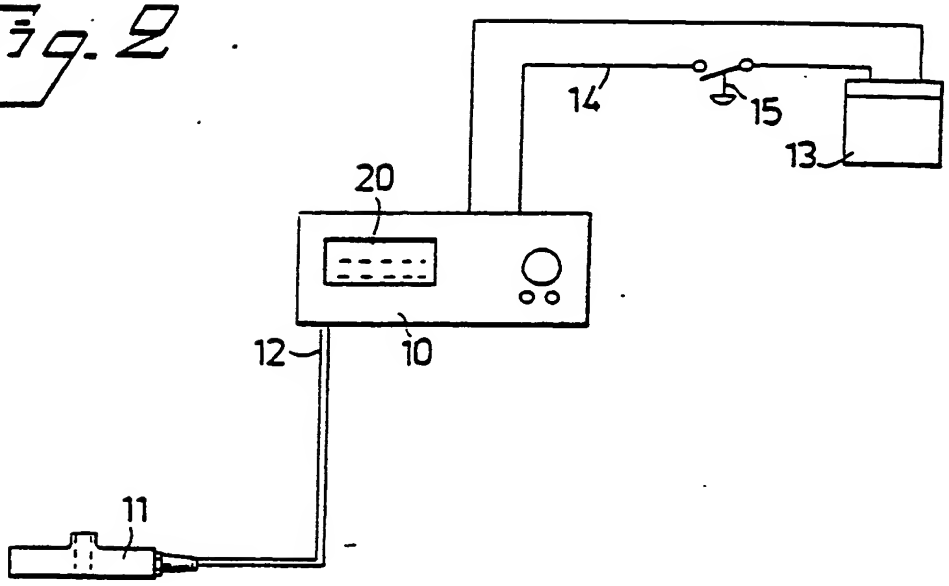

Fig. 3

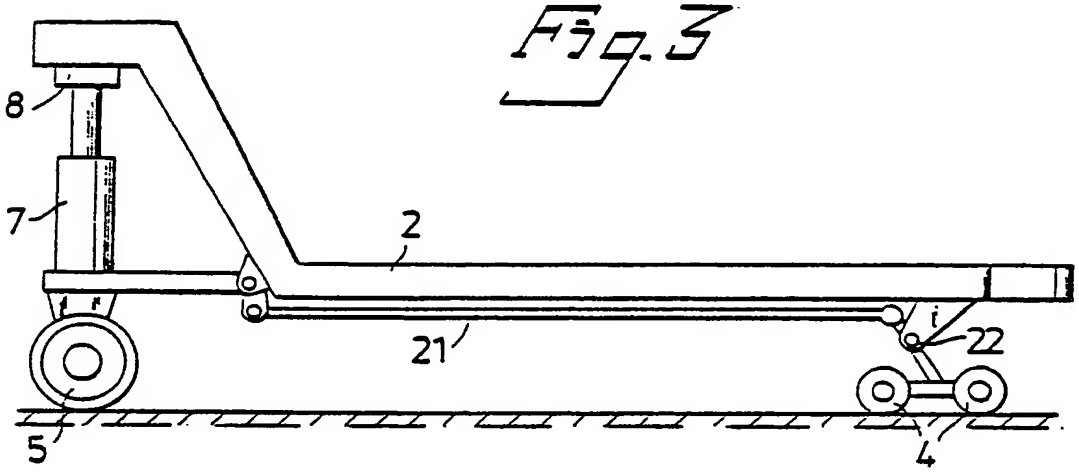

Fig. 4